that are associated with the loading on the blade, whereas the pattern of the second and third cycles is determined by the flexibility of the control system as the twisting forces on the blade cause the blade to oscillate in and out of stall. These results suggest that analytical methods need to be tested for steady flight conditions initially and, if successful there, then applied to maneuvering flight.

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Modeling UH-60A Control System Stiffness

Robert Kufeld

Accurately predicting the dynamic stall characteristics of a helicopter rotor has become one of the major goals of the rotorcraft industry. The loads during this flight condition are important, for they are used to size the helicopter control system. In addition, improved predictions should reduce the design and development cost of new helicopters. To accurately predict these dynamic stall characteristics, accurate models of the rotor structure, control system stiffness, linear and nonlinear aerodynamics, and rotor inflow are required.

The objective of this work was to focus on improving the control system model of the UH-60A helicopter and thus improve the prediction of its dynamic stall characteristics. The recent flight testing of the UH-60A at Ames Research Center provided a wealth of data on observations of the dynamic stall phenomenon; the data are ideally suited for comparison with calculations from comprehensive rotorcraft analyses. In addition, current models of the UH-60A control system stiffness were based on an analytical estimate and never verified.

A direct measurement of the UH-60A control system stiffness was made, and a summary of the collective loading results is shown in the figure. These data show that the measured collective control-system stiffness is a function of the rotor azimuth, as opposed to the constant value typically used. The data also show that the maximum value of the measured stiffness near 165 degrees rotor azimuth is more than 4 times that used in the current model.

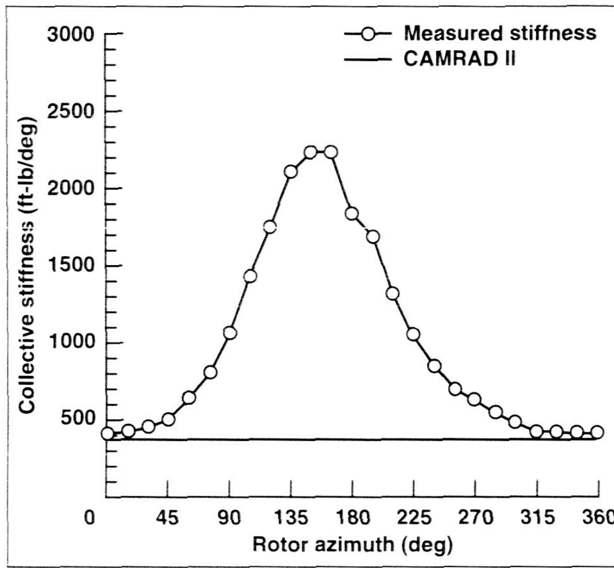

Fig. 1. Measured and calculated UH-60A control-system stiffness versus rotor azimuth.

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